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RESEARCH PAPER

SCM professionals' competences in Brazil

Manoel Andrade da Silva Reis[1], Claudio Minerbo[1], Priscila Laczynski de Souza Miguel[1]

[1]Getulio Vargas Foundation, São Paulo School of Business Administration, Logistics and Supply Chain Study Center, Operations Department, São Paulo, SP, Brazil.

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ABSTRACT

Goal: This paper aims to examine the competences required from supply chain management professionals in Brazil.

Design / Methodology / Approach: A survey with 239 professionals explored 44 different competences they deemed important, followed by a principal component analysis, t-tests and ANOVA.

Results: Competences can be grouped in eight categories, some of which updated to reflect the changes in the SCM practice. It reinforces the importance for general behavioral, technical, analytical and business competences, suggested in previous research, and provides a more granular view and emphasizes differences of technical expertise depending on the scope of the manager's function. Technology, information systems and quantitative skills are different competences required to support changes in e-commerce and digital transformations.

Limitations of the investigation: Differences among industry sectors or functions should be investigated in more detail due to respondent´s heterogeneity

Practical implications: Our study can serve as a guide when searching new talents and training SCM professionals, as it emphasizes both competences common to all SCM functions as well as specific depending on their scope.

Originality / Value: Firms operating in service sectors generally demand higher levels of business awareness competences than the ones in manufacturing sectors. This reflects the service-dominance logic, where service is the fundamental basis of exchange and firms need to be more customer oriented.

Keywords: SCM Professional; SCM Competences; Brazil.

INTRODUCTION

Supply Chain Management (SCM) plays a key role in creating value for companies by reducing costs and increasing customer satisfaction through better quality, on-time delivery, responsiveness, innovation, and services. SCM competences are considered an important antecedent for supply chain integration (Suttiwatnaruput et al., 2014), and the use of advanced SCM practices can make a difference in an organization's success or failure to meet customer needs and stay in business (Fawcett and Waller, 2013).

SCM professionals´ initial work has been in other sub-disciplines, such as transportation and warehousing, and as they ascend the management tree the requirements to make decisions go beyond their previous experience (Tatham et al., 2017). Significant changes in SCM processes and increasing importance of SCM functions on firm's competitiveness is

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leading to new demands of SCM professionals, requiring more managerial and analytical competences than technical skills (Hohenstein et al., 2014; Derwik and Hellström, 2017). Recent trends, such as globalization, customer centricity, sustainability, resilience and new technologies, have accelerated these changes (Derwik et al., 2016; Min et al., 2019). Within this context, decision making is shifting from functional perspectives to multidisciplinary and strategic ones.

In this strategic role, SCM practitioners are responsible for high-level decision-making in organizations (Fawcett and Waller, 2013; Hohenstein et al., 2014). Consequently, broader and more diverse set of competences are required from SCM managers than others due to the different functions they perform and their position in the hierarchy of organizations (Suttiwatnaruput et al., 2014).

Research aiming to understand or manage the competences required of SCM professionals is still inconclusive, as definitions of the required competences are fragmented. Recent research indicates that there are more than 280 competences attributed to this professional (Kotzab et al., 2018), and there is an overlap of definitions and terminologies along with a lack of consensus on which competences are more relevant (Derwik and Hellström, 2017). Moreover, the high variability in what is demanded of supply chains as well as regional and industry differences presents a challenge when trying to define the SCM professional (Zinn and Goldsby, 2014). Thus, there is a growing concern related to the shortage of talent and professionals capable of dealing with current evolving demands (Hohenstein et al., 2014; Kotzab et al., 2018).

Studies on the theme have been restricted to few regions, primarily the US and Europe (Gammelgaard and Larson, 2001; Mangan and Christopher, 2005; Giunipero et al., 2006; Murphy and Poist, 2007; Jim Wu, 2007; Bak and Boulocher-Passet, 2013; Bernon and Mena, 2013; Lorentz et al., 2013; Onar et al., 2013; Kotzab et al., 2018) and a few countries in Asia (Jim Wu, 2007; Kam et al., 2010; Prajogo and Sohal, 2013; Sohal, 2013; Suttiwatnaruput et al., 2014). Therefore, to be more generalizable investigations need to be expanded to other countries and regions, such as South America. In Brazil, the only manuscript found was a study of logistics competences focused in mid-sized supermarkets (Campos et al., 2019), which suggested that general competences (i.e. managerial skills) are more important than specific skills (i.e. technical and functional).

To address these gaps, this study answers the research question: *What are the competences required for SCM professionals in Brazil?* The researchhas two main objectives: map and synthesize SCM professional competences in Brazil, and identify which ones are more demanded from practitioners. Brazil is worth studying because it is the eighth largest economy in the world, its logistical cost is estimated at about 11% of Gross Domestic Product (Marchetti and Ferreira, 2012), and logistics challenges differ from the other countries already studied. To achieve these objectives, a survey was conducted with 239 supply chain Brazilian professionals and analyzed by means of Principal Component Analysis (PCA), ANOVA and t-tests.

This research contributes to the academic and practical development of SCM in several aspects. First, the use of an empirical and structured method to analyze several competences found in the literature led to an updated model with eight categories of skills that reflects the changes in the SCM practice. Second, it provides additional support and helps generalize results regarding the so-called soft skills, business management and administrative practices, which are required no matter the function or context of the SCM professional. Third, it suggests that companies operating in service sectors seem to demand higher levels of competencies than general manufacturing ones. More specifically, this was significant in business awareness competencies, which are composed of sustainability, quality management, team leadership and customer services skills. These results support the service-dominant logic (S-D Logic, Lusch 2011 p. 14), which argues that customers want access to the flow of service, and not only the output or product that firms produce and there is a stronger interaction among actors.

Next section presents the theoretical background showing how SCM professional evolved over time, and synthesizes different skills found in the literature into 44 different competences. In the methodology section, methods and data collection are described and the PCA method used in this study is presented, followed by the results. The discussion section provides the implications, and the paper ends with the conclusions, limitations, and suggestions for future research.

LITERATURE REVIEW

The evolution of the SCM professional

Supply chain management has constantly evolved since the concept of integrating procurement and logistics was introduced in the 1980s. At this time, its focus shifted from increasing efficiency to improving value creation to the final customer through relationship management and coordination (Min et al., 2019). Supply chains are now required to be efficient, responsive, agile, resilient, responsible, innovative and adaptive (Christopher and Ryals, 2014; Min et al., 2019). Additionally, the undergoing digital transformation will require integrated supply chains via new technologies and digital platforms (Büyüközkan and Göçer, 2018; Min et al., 2019). SCM professionals must cope with these constant changes and requirements by adopting more proactive behaviors (Prajogo and Sohal, 2013) and being more strategic than technical (Derwik et al., 2016; Min et al., 2019).

SCM competences

The debate on the competences required from SCM professionals started in the beginning of 2000 and has considered both practical and educational perspectives. Nevertheless, despite the large body of research, knowledge about SCM competences is still fragmented and inconclusive as research and definitions on the topic varies in terms of scope and meaning (Derwik and Hellström, 2017; Campos et al., 2019).

Although combining technical, managerial and soft skills has been emphasized by different authors, research has been carried out in an independent manner. As a result, several categories containing different sets of skills/competences were defined, leading to a wide variety of terminologies and concepts. For example, Gammelgaard and Larson (2001) identified SCM professionals require core (or technical) skills, interpersonal/managerial competences, as well as quantitative/technology skills in order to outperform in their jobs. Murphy and Poist (2006) suggested three categories of logistics managers' skills: business (i.e., knowledge of other functional areas), logistics, and management (planning, organizing, and personal). For Giunipero et al. (2006), SCM professionals should develop five categories of competences, including team building, strategic planning, communication, technical, and financial skills. Moreover, Prajogo and Sohal (2013) proposed four categories of competences, including communication and teamwork, technological, initiative and enterprise competences, compliance and legal skills. Suttiwatnaruput et al. (2014) identified two sets of skills for SCM professionals: one focused on technical knowledge and applications, including technical, SCM fundamental functions, analytical skills, business processes knowledge; and another focused on traits and management (also known as soft competences), including communication, change and conflict management.

Similar findings were observed from an educational perspective, which claims that there is a need to better align educational programs with the practitioners´ requirements, and include technical skills, business management, quantitative methods, and business dynamics awareness (e.g. commercial and marketing, technology, legal and regulations knowledge), as well as soft skills (Jim Wu, 2007; Bernon and Mena, 2013; Onar et al., 2013).

Recent literature reviews also emphasize the need of functional/technical, managerial/strategic competences, as well as relational and behavioral skills (Derwik and Hellström, 2017; Karttunen, 2018), and brought more clarity on some of these concepts.

Accordingly, technical and functional skills are related to knowledge of specific tasks functions and processes in SCM, while managerial and strategical competences include business analysis and management, financial and regulatory skills, commercial awareness and industrial experience and intelligence. Karttunen (2018) compare the skills required by a Purchasing manager with those required by an entrepreneur. Managers should "scan the environment" and build an end-to-end perspective, at the same time that they recognize and capitalize opportunities. Relational skills refer to communication, teamwork, cross-functional awareness and relationship management (internal, with customers, and suppliers). Behavioral or social skills encompasses self-management, self-motivation, empathy, leadership, creativity, and cognitive skills. Recently, new concepts have been introduced, such as the need of political skills related to the capacity to influence, persuade and engage others (Karttunen, 2018).

Moreover, depending on the manuscript, the number of competences and skills assessed in different studies varied from 12 to 83 (Table 1).

Table 1: Examples of competences assessed in a sample of articles

Author	Categories of competences	Number of Competences
Gammelgaard and Larson (2001)	Interpersonal/managerial, quantitative/technological, and SCM core skills	45
Murphy and Poist (2006)	Business, logistics, and management	83
Giunipero et al. (2006)	Team building, strategic planning, communication, technical and financial	15
Prajogo and Sohal (2013); Sohal (2013)	Communication and teamwork, technological, initiative and enterprise, compliance and legal	19
Onar et al. (2013)	Supply chain management, business management, quantitative methods, technology/systems, marketing, finance/economy, law and legal, and soft skills	29
Lorentz et al. (2013)	Manage demand and supply uncertainty, design and manage intra-organizational processes, traditional related logistics skills	12
Bernon and Mena (2013)	Leadership and strategy, financial, general management, and technical/functional skills	35
Suttiwatnaruput et al. (2014)	Technical knowledge and application, and traits and management	20
Derwik et al. (2016)	Behavioral, business managerial, generic, functional, and SCM expertise	29
Derwik and Hellström (2017)	Functional, relational, managerial, and behavioral	39
Tatham et al. (2017)	Sense and shape opportunities and threats, seize opportunities, maintain competitiveness,	25
Kotzab et al. (2018)	Personal skills, leadership skills, international perspective, logistics knowledge, resource integration, market/business knowledge, international trade, risk management, and environmental awareness	50

Source: The authors themselves

Kotzab et al. (2018) identified more than 280 skills and competences discussed in the literature, and suggested that there is insufficient empirical evidence on competences required of SCM professionals in different areas. Moreover, although competences have been discussed in terms of clusters (also referred as categories or areas), the ambiguity and lack of uniformity found in the definitions brings additional difficulties in comparing and replicating

results. Finally, despite some consensus in the literature, competences and categories are sometimes presented with overlapping terminologies for similar concepts, and other times in a complementary manner with new and different measures.

In summary, the literature suggests a need to evaluate and consolidate different studies, propose a new and updated framework that synthesizes and addresses the current overlap among the required competences, and provide greater consensus and clarity on the types of competences required of SCM professionals.

METHODOLOGY

This study aims to map and synthesize the competences required of SCM professionals in Brazil, and identify which ones are more demanded from practitioners. An exploratory quantitative research was conducted based on a survey (Forza, 2002), and principal Component Analysis (PCA) was used to reduce the large number of variables, revealing which competences relate to a respective factor assessed and facilitating interpretation and analysis (Tabachnick and Fidell, 2007; Hair et al., 2010). Anova and t-tests identified the most demanded competences depending on the respondent´s context.

Sample and data collection

Respondents were selected from three independent sources to assure randomness and sample variety: an existing database at the Logistics and Supply Chain Study Center that coordinated this research, subscribers to a leading supply chain management magazine, and a database focused on supply chain management professionals acquired from an database marketing firm. Questionnaires were submitted via SurveyMonkey online software. An email message was sent to the professionals, describing the study and a link to the survey. In order to increase the rate of responses (Forza, 2002), respondents were invited to participate in a panel session to be held at the end of the research, where results would be presented and discussed. A follow up reminder was sent 15 days later.

From a total of 281 questionnaires received, 42 were incomplete and were 239 valid responses. Potential differences between respondents from the different databases and the first and second message were analyzed through ANOVA and t-test (Armstrong and Overton, 1977), and no significant differences were found.

Respondents worked in six main industries, most of them with annual revenues greater than USD 15 million (Table 2). In total, 170 respondents (65%) reported that the logistics/SCM area was formally structured within their companies, from which 65% worked in companies with annual revenues above USD 30 million, indicating that smaller companies still lack a formal logistics/SCM area. Results also indicate that in 53% of the companies the supply chain department reported to the president/vice president, in 36% of cases to operations, and in 14% of cases to sales/marketing. Company size does not seem to impact this profile.

Table 2: Respondent Profile

Industry	% of responses	Annual revenue (USD million)	% of responses	Structured SCM area
Logistics services	14%	Up to 0.2	5%	5%
Professional services	13%	From 0.2 to 3	6%	14%
Consumer goods	12%	From 3 to 15	11%	9%
Wholesale / distribution	10%	From 15 to 30	14%	8%
Metal, mining, paper	9%	From 30 to 150	17%	13%
Automotive and auto-parts	8%	Above 150	47%	51%
Other (32)	34%			
Total	100%	Total	100%	100%

Source: The authors themselves

Measurements

In order to obtain a more comprehensive set of measurements, it was first necessary to obtain a detailed list of skills, standardize their terms, and then synthesize the list with the corresponding variables. This was accomplished by reviewing and comparing the list of skills identified in the literature. For example, straightforward competences such as "planning and control of transport operations", "transportation" and "transport" were conceptually similar, and therefore synthesized and termed as "transportation".

Competences found in too broad or generic terms were redefined based on their contextual meaning. For instance, several terms were related to technology, such as "systems concept", "technology awareness", "information systems", "IS for logistics", "database ability", "IT Systems development", "computer programming", "software knowledge", "knowledge of latest technology knowledge of newest techniques", "Efficient consumer response (ECR)" and "e-commerce". In order to provide a more comprehensive view, these skills were measured according to three different terminologies: "understand about operational systems (WMS, S&OP, TMS)", "Understand about management systems (SAP, Oracle, ...)" and "Understand about e-commerce systems".

Finally, three new terms were included because they are considered trends in supply chain management practices in Brazil and may be applicable to other regions as well: Traffic restrictions in cities or roads was added, because large cities with more than 10 million habitants, such as São Paulo, are imposing severe restrictions that require expertise to be solved. Loss prevention was included because it is a crucial issue to be managed in retail, and business promotions was included because it is a key component in e-commerce.

At the end of this process, a final list of 44 different skills was obtained. Zhang and Chen (2008) reported that surveys with too many questions may lead to common method variance due to respondent fatigue (i.e. when respondents agree (or disagree) with questions independently of their content), which is a frequent concern of researchers. With the goal of reducing complexity and facilitating the understanding of what was actually being asked, they were grouped into five different categories (Appendix 1): (i) interpersonal relationship with six skills; (ii) strategic mindset with five skills; (iii) operations and supply chain management with twenty skills; (iv) technology and process with seven skills; (v) familiarity with other areas within the organization with six skills. These categories were developed based on the researchers' extensive academic and practical experience in the field and were used only to facilitate respondent's effort to complete the survey.

Questionnaires and pretesting

A brief explanation of each category with their corresponding competences was presented in the questionnaire, and the respondent was asked to rank each variable on a five-point Likert scale (from 1= Insignificant to 5= Essential). The questionnaire also contained contextual information about the respondent and the firm he worked for, which could be used to assess potential differences depending on the respondent's context, such as the sector in which the respondent's firm operates and revenues.

A pre-test was conducted with a group of eleven SCM professionals and researchers. This helped to certify that the questions and categories were clear, the time to answer the questionnaire was adequate, and no other potential problems could arise with the questionnaire.

DATA ANALYSIS AND RESULTS

Data reliability was assured by means of three statistical tests (Tabachnick and Fidell, 2007; Hair et al., 2010): the number of significant correlations at the 0.01 level proved to be high (>75% above 0.3), the Kaiser-Meyer-Olkin (KMO) test that measures sample correlation patterns had a result of 0.84 (> 0.50), and the Bartlett's test of sphericity that measures adequacy of sample correlations presented an acceptable significance level ($p = 0.00$). Therefore, the sample was considered acceptable for using PCA.

SCM professional's competences

A first PCA analysis was conducted without specifying the number of factors so that the main constructs could be identified. From eleven factors identified with Eigenvalue above 1.0, the first four were greater than 2.0, and variations started to become smaller after the sixth factor. A scree plot was used to identify a region of curve where the eigenvalue slope changed, indicating that seven to nine factors were likely to be extracted.

Based on these results, three different PCA´s were run to determine the optimal number of factors with seven, eight, and nine factors to be extracted. In each one, varimax rotation was used, and results were analyzed based on the total variance extracted and factor loadings of the variables. Although load factors above 0.71 are considered excellent, 0.63 very good, 0.55 good, 0.45 acceptable, and 0.32 bad (Tabachnick and Fidell, 2007, p. 649), setting the cut-off point based only on recommended values may not be the most suitable choice. Instead, they should be determined by the researcher because sometimes an extracted factor cannot be interpreted from a practical point of view.

The model with eight factors (Table 3) was considered the most appropriate. Despite having 56% of the total variance explained, the number of variables with load factors close to or above 0.45 was similar to the model with nine factors, and all factors could be interpreted from a practical point of view. For ease of interpretation, a categorical name was given to each factor, and respective competences were grouped and sorted according to their factor loading. The variables demand planning and planning had loadings below.40 and were not linked to factors, thus excluded from the analysis (Gammelgaard and Larson, 2001).

Factor 1 (logistics and distribution technical competences) is primarily associated with the flow of goods in the distribution chain, and relates to the general understanding of transportation, inventory management and handling and warehousing. Factor 2 (negotiation and purchasing knowledge) encompasses skills of selecting, negotiating, and managing suppliers, and is aligned with the Procurement function. Factor 3 (technical specific expertise) considers skills required for professionals with specific functional scope, such as international trade or reverse logistics. Factor 4 (analytical competences) includes project management and network design, as well as financial knowledge and cost analysis.

Factor 5 (soft skills) includes the ability to influence and communicate with internal or external stakeholders. Factor 6 (business dynamics awareness) relates to the capacity to lead teams in order to improve customer satisfaction, and emcompasses team leadership, knowledge about customer service, quality management, and sustainability. Factor 7 (systems and processes expertise) refers to the familiarity and capacity to implement new technologies and information systems for process improvement. Factor 8 (knowledge about other areas) refers to the familiarity that professionals have with tasks performed in areas related to SCM, such as finance, human resources, sales.

Table 3: Factors and Competences

Factor / Competences	Factor Loading	Variance Explained	Cumulative Variance
Factor 1. Logistics and distribution competences		**25.0**	**25.0**
V1: Handling and storage	0.79		
V2: Distribution	0.76		
V3: Transportation	0.60		
V4: Inventory management	0.56		
V5: Integrated logistics	0.46		
V6: Loss prevention	0.40		
Factor 2: Negotiation and purchasing knowledge		**6.2**	**31.2**
V1: Negotiation practices	0.73		
V2: Commercial promotions	0.71		
V3: Manage the supply base	0.67		
V4: Discount policies	0.65		

Table 3: Contined...

Factor / Competences	Factor Loading	Variance Explained	Cumulative Variance
V5: Order aggregation	0.62		
Factor 3: Technical specific expertise		**5.3**	**36.5**
V1: International trade and logistics	0.75		
V2: Legal and tax aspects	0.65		
V3: Reverse logistics	0.54		
V4: Distribution in large urban centers	0.52		
V5: Risk management	0.47		
Factor 4: Analytical competences		**4.7**	**41.2**
V1: Costs	0.64		
V2: Financial analysis	0.63		
V3: Analytical and quantitative skills	0.57		
V4: Project management	0.55		
V5: Problem diagnosing and solving	0.44		
V6: Network design	0.44		
Factor 5: Soft skills		**4.1**	**45.3**
V1: Relationship with internal stakeholders	0.74		
V2: Relationship with external stakeholders	0.67		
V3: Communication	0.65		
V4: Manage change	0.55		
V5: Develop successors	0.54		
V6: Decision making	0.48		
Factor 6: business dynamics awareness		**3.8**	**49.1**
V1: Sustainability	0.61		
V2: Quality management	0.56		
V3: Team leadership	0.52		
V4: Customer services	0.50		
Factor 7: Systems and processes expertise		**3.5**	**52.6**
V1: Management systems (i.e., SAP, Oracle)	0.83		
V2: Operational systems (i.e., WMS, TMS)	0.76		
V3: E-commerce	0.63		
V4: Systems and process integration	0.59		
Factor 8: Knowledge about other areas		**3.4**	**56.0**
V1: Accounting	0.72		
V2: Sales	0.64		
V3: Finance	0.63		
V4: Marketing	0.61		
V5: Human resources	0.53		
V5: Procurement	0.42		

Source: The authors themselves

Relevance of SCM competences for professionals in Brazil

A first-order measurement value for each factor was necessary to determine and compare the relevance among them (Mullen, 1995; Liu et al., 2009). This was accomplished by computing the average score of each competence within each factor, for each respondent. For example, analytical competences (Factor 4) was obtained by averaging the responses for costs, financial analysis, analytical and quantitative skills, project management, problem diagnosing and solving, and network design. Anova and Tukey Pairwise Comparisons were conducted to analyze which factors can be considered more relevant than others, without taking any context segmentation in consideration (Table 4).

Results at 95% confidence levels clearly show four distinct groups of relevance: Soft skills (factor 5) was ranked as the most relevant one, followed by a group containing logistics and

distribution technical competences (Factor 1), business dynamics awareness (Factor 6) and analytical competences (Factor 4) with similar relevancy. A third group ranked as mid to low importance was composed of technical specific expertise (Factor 3), systems and processes' expertise (Factor 7) and knowledge about other areas (Factor 8). Negotiation and purchasing knowledge (Factor 2) were ranked last.

Table 4: Relevance of SCM competences

Factor - Category	Mean	StDev	95% CI Level	Relevance
5- Behavioral competences	4.48	0.40	4.41 ; 4.54	1
1- Logistics & distribution competences	4.27	0.50	4.20 ; 4.33	2
6- business dynamics awareness	4.24	0.47	4.17 ; 4.30	2
4- Analytical competences	4.13	0.46	4.07 ; 4.20	2
7- Systems and processes expertise	3.92	0.61	3.86 ; 3.99	3
3- Technical specific expertise	3.92	0.57	3.85 ; 3.98	3
8- Knowledge about other areas	3.88	0.48	3.81 ; 3.94	3
2- Negotiation & purchasing knowledge	3.65	0.62	3.58 ; 3.72	4

Source: The authors themselves

Differences and similarities among the respondent´s context

ANOVA was conducted to compare each factor according to two contextual variables. One was firm size, based on the annual revenues asked in the questionnaire, but no diferences were found. The other was the sector where the respondent's firm operates, which could be base materials (i.e. mining, steel, agri-business and construction), general manufacturing (i.e. consumer goods, automotive, electro-electronics and auto-parts), services (i.e. retail, logistics, healthcare), and professional services (i.e. consulting and trading).

According to the results (Table 5), five out of the eight factors had at least one mean value that could be different from others at significance level α = 0,05 (2-Negotiation & purchasing knowledge, 4- Analytical competences, 5- Behavioral competences, 6- business dynamics awareness and 7- Systems and process expertise).

Table 5: Relevance of SCM competences according to firm sector

		Total Sample	Base Materials	General Manufacturing	Services	Specialized Services
	N	239	32	89	84	34
Factor - Category	p-value	Mean Values				
5- Soft skills	0.05	4.48	4.84	4.42	4.57	4.40
1- Logistics & distribution	0.11	4.26	4.21	4.19	4.37	4.25
6- Business dynamics awareness	0.01	4.24	4.23	4.12	4.36	4.27
4- Analytical competences	0.04	4.13	4.27	4.03	4.19	4.13
3- Technical specific expertise	0.47	3.92	3.94	3.84	3.96	3.98
7- Systems and process expertise	0.05	3.92	3.91	3.79	4.02	4.05
8- Knowledge about other areas	0.51	3.84	3.86	3.84	3.94	3.83
2- Negotiation and purchasing	0.05	3.65	3.49	3.58	3.79	3.64

Source: The authors themselves

A more in-depth analysis was conducted to compare each of these five factors against sectors. Since the analysis should consider four different sectors to be consistent, six pairwise tests were required to assess all possible combinations for each factor. Anova was conducted one more time for all factors, with Tukey and Bonferroni adjustment methods applied to protect against errors when multiple comparisons are being made for one factor.

Differences exist only between firms in services and base manufacturing sectors, and in five factors (Table 6). For example, while Anova for Analytical competences (Factor 4) reported a mean difference of 0.16 between services and general manufacturing sectors (at p-value of 0.04), Tukey pairwise comparison reported a p-value of 0,10 and Bonferoni test reported a p-value of 0.13. Although comparisons without adjustments indicate that differences were significant for the other competences, results cannot be regarded as conclusive. Similar results were obtained for negotiation & purchasing knowledge, soft skills, and systems and process expertise, (comparisons with adjustments reported p-values in the range of 0.08 to 0.13).

Therefore, it is only possible to conclude that differences exist at significant levels only on business dynamics awareness (Factor 6), with services showing higher means than general manufacturing. Nevertheless, our findings suggest that service organizations may require higher level of competences than general manufacturing companies.

Table 6: Pairwise Comparison for factor averages: Services vs general manufacturing

Factor – Category	ANOVA		Pairwise Methods		Support
			Tukey	Bonferroni	
	Difference of means	p-value	p-value	p-value	
2- Negotiation & purchasing knowledge	0.21	0.05	0.10	0.13	Inconclusive
4- Analytical competences	0.16	0.04	0.10	0.13	Inconclusive
5- Soft skills	0.15	0.05	0.07	0.09	Inconclusive
6- business dynamics awareness*	**0.24**	**0.01**	**0.01**	**0.01**	**Yes**
7- Systems and process expertise	0.23	0.05	0.06	0.08	Inconclusive

* Indicates group means significantly different at $p < 0.05$. Source: The authors themselves

DISCUSSION

Results provide an updated and more detailed set composed of eight categories of skills, and brings several contributions that may reduce the existing complexity and overlap among them.

First, it suggests that technical skills should be evaluated in a more detailed and granular manner than previous studies, which tend to discuss such competencies in broader functional terms under the SCM umbrella such as technical knowledge and application (Suttiwatnaruput et al., 2014), technical/functional (Bernon and Mena, 2013) or supply chain management (Onar et al., 2013).

In contrast, by decomposing technical skills in three clear and distinct groups (logistics and distribution, negotiation and purchasing, and specific expertise), we clearly distinguish the profile of the logistics manager from the procurement manager or specialist. This highlight the variability and relatively larger scope of the SCM professional's profile, and reinforce that the so-called technical competences differ in relation to the professional's function within the firm (Sohal, 2013; Zinn and Goldsby, 2014).

Second, our results corroborate with previous research (Gammelgaard and Larson, 2001; Prajogo and Sohal, 2013; Derwik et al., 2016) by showing that business management and administrative practices are also required, no matter the function of the SCM professional. Our research also support and helps generalize results regarding the so-called soft skills, which include elements from relational, social and behavioral competences (Derwik and

Hellström, 2017; Karttunen, 2018; Bak et al., 2019) and are increasingly demanded and required by the supply chain manager (Onar et al., 2013; Jim Wu et al., 2013; Derwik et al., 2016).

Additionally, by proposing knowledge about processes and information systems as a specific set of skills, this research emphasizes that as organizations are on track to support changes in digital transformation, SCM professionals should be capable of evaluating different technologies and scenarios for decision-making The proposed skills set differs from previous studies that consider technology and information systems as the ability to apply continuous improvement and focus on the customer (Onar et al., 2013), or consider quantitative/technological skills, the ability to develop computer programming and software knowledge as a category of skills (Gammelgaard and Larson, 2001).

Finally, our study found that knowledge about other organizational areas is a set of skills as poposed by Murphy and Poist (2006), and addressed an area that was not found in previous empirical research.

Skills relevance

According to Table 5, soft skills (Factor 5) are considered the most relevant competences. They contribute to influence and persuade different stakeholders (Derwik and Hellström, 2017; Karttunen, 2018) and will be constinuously demanded in the changing supply chain scope (Bak et al., 2019).

Three factors were classified as second priority and highlight the importance of knowing SCM from a technical and analytical perspective: The first relates technical skills of logistics and distribution, which are particularly relevant in the Brazilian context because the country has its own peculiarities for planning and distributing goods, such as a lack an appropriate logistics infrastructure and is heavily dependent on road tansport. Kam et al. (2010) noted that inappropriate infrastructure may impact areas such as inventory management and risk. Also, Brazil has experienced a drop in the skills and quality of logistics service providers between 2010 and 2015 (World Bank, 2018), requiring more technical expertise to manage the daily operations.

The second category, business dynamics awareness, is key due to the market trend focused on customer centricity (Christopher and Ryals, 2014; Min et al., 2019). The constant need to add value to final consumer requires the SCM professional to develop strategic and business awareness skills in order to anticipate trends and incorporate supply and demand management to better serve the end customer and lead teams in order to achieve better results. This is even more relevant in services companies than manufacturing ones, probably due to the observation captured by the S-D Logic (Lusch, 2011) that SCM is integrating the functions of marketing, product development and customer service. According to this perspective, the supply chain is referred as a service ecosystem, where customer experience is more important due to the greater interaction with the consumer, and customer satisfaction is more significant than the products that firms produce.

The third category, analytical competences, are managerial skills that help to plan, operate and control different SCM processes, minimizing costs while considering different variables and scenarios (Derwik and Hellström, 2017). Analytical skills have been considered relevant for a long time (Gammelgaard and Larson 2001) and will certainly continue to be important for the SCM professional, considering the constant need to work with data science and the growing uncertainty about the future.

Ranked in third position are three competences. Knowledge about other functional areas has been long cited in the literature as cross-functional awareness (Gammelgaard and Larson, 2001), and understanding of others' work is key to persuade others (Karttunen, 2018). Systems and processes expertise can be also thought as a functional skill that encompasses technology awareness and process management (Derwik and Hellström, 2017), particularly important with the emergence of new technologies (Christopher and Ryals, 2014; Min et al., 2019) as supply chains become digital (Büyüközkan and Göçer, 2018). Technical specific expertise is

required depending on the scope of the SCM professional (e.g. international logistics, electronic retailing). A possible explanation for these four factors being considered less relevant is the fact that skills demanded by SCM professional depend on the context they are embedded (Karttunen, 2018) or the scope of their functions (Zinn and Goldsby, 2014), reinforcing the difficulty to identify the SCM professional identity.

Negotiation and purchasing knowledge (Factor 2) was the least important competence, and may be related to the heterogeneity of the sample. Karttunen, (2018) compared the skills required by purchasing managers with those required by entrepreneurs, and it may be necessary to differentiate logistics professionals from procurement specialists to allow a better comparison.

CONCLUSIONS

The present study aimed to answer the research question: *What are the competences required by SCM professionals in Brazil?*

Findings revealed eight groups of skills required for SCM professionals and contribute to the current debate in supply chain management in different manners. Although several technical, soft, and business skills suggested in the literature were also found, results indicate that technical skills should be assessed in three separate categories: technical logistics and distribution, negotiation and purchasing, and specific technical expertise. This distinction reinforces the variability of the profile, scope, and requirements of this professional, since they can have a logistics, procurement, or SCM profile. Effects of digital transformations were also captured in this study, since the familiarity with new technologies and information systems were considered a specific set of skills.

From a practical perspective, results reinforce that as SCM professionals are assuming new roles and higher responsibilities in decision-making, soft skills are becoming the most relevant ones. On the technical side, at the same time that managers should be proficient on core technical logistics skills, business skills focused on customer centricity and analytical skills, they also need to be updated on technologies that support the digital transformation. Moreover, our study can serve as a guide when searching new talents and training SCM professionals as it emphasizes which competences are common to all different functions in SCM and which are specific depending on their scope. Finally, SCM professionals still do not perceive the relevance of being familiar with other internal areas within their organizations, a gap still to be fulfilled.

The present research has some limitations that could be overcome in future studies. First, results in terms of industry sector or function are still inconclusive due to sample size and respondent´s heterogeneity. Future research could focus on specific sectors or respondent´s role for a better understanding of how context variables influence these competences. Despite the geographical vastness and regional differences in Brazil, it was not possible to assess whether there are differences between professionals according to the location of their firms, and future studies could assess for such differences. Although the detailed principal components method was helpful to identify how different skills relate to each other, an updated measurement instrument should be validated by means of a confirmatory study to adapt to new and recent trends in SCM and increase the robustness of findings.

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APPENDIX

Appendix 1: Measurements used in the survey (Likert scale)

Measurement	Examples of terminologies found in the literature	Key references
Considering [category of skills], please rate how important the following skills should be for the logistics / supply chain professional:		
(i) Interpersonal Relationships		
Relate with the external public (suppliers, customers, etc. ...)	Manage supplier relations, manage customer relations, manage external relationships	Murphy and Poist (2006)
Relate with the internal public (inter-areas)	Multidisciplinary knowledge for SCM, interpersonal relations, listen and empathize	Murphy and Poist (2006)
Be able to manage change	Change management, adapt to change, leading change	Gammelgaard and Larson (2001); Murphy and Poist (2006)
Lead and influence teams	Lead individuals and groups, listening, motivation, confidence, conflict management, leadership, teamwork, motivate others, delegate, enthusiasm, self-awareness, empathy	Gammelgaard and Larson (2001); Murphy and Poist (2006)
Identify and train successors	Train/mentor, coaching successors	Murphy and Poist (2006); Jim Wu et al. (2013)
Have good communication (write, speak, listen)	Communicate effectively, presentation skills, oral communication, written communication, presentation, public speaking and writing	Gammelgaard and Larson (2001); Murphy and Poist (2006)
(ii) Strategic Mindset		
Be able to make decisions	Decision-making ability, formulate and develop logistics strategies, strategic awareness, prioritizing, ability to see the "BIG Picture", goalsetting, integrative decision making	Gammelgaard and Larson (2001); Murphy and Poist (2006)
Know financial and investment analysis	Knowledge of finance and basic accounting, making the business case, financial knowledge, break even analysis	Jim Wu et al. (2013); Campos et al. (2019)
Know cost analysis (total cost / ABC, profitability, allocations)	Budget and cost control, cost accounting, total cost analysis, activity-based costing	Bernon and Mena (2013); Campos et al. (2019)
Know the aspects of network design and distribution channels	Modeling and optimization, facility location analysis, network design	Bernon and Mena (2013); Lorentz et al. (2013)
Be able to identify and manage logistics / supply chains risks	Risk management	Jim Wu et al. (2013)
(iii) Operations Management		
Transportation	Planning and control of transport operations, transportation, transport	Lorentz et al. (2013); Onar et al. (2013)

Handling and storage	Receipt, storage, handling and dispatch of goods, materials handling, storage management	Jim Wu et al. (2013); Campos et al. (2019)
Distribution	Delivery management, customer and distribution channel management, route planning	Lorentz et al. (2013); Jim Wu et al. (2013)
Traffic restrictions in cities or roads	New, based on management practices	N/A
Logistics and international / global trade	Management of international logistics processes, knowledge of international trade, international logistics	Lorentz et al. (2013); Jim Wu et al. (2013)
Reverse logistic	Reverse logistics, return goods handling	Lorentz et al. (2013); Campos et al. (2019)
Loss prevention	New, based on management practices	N/A
Demand forecast methods	Demand management and order processing, forecasting, demand forecast and supply planning, materials management	Murphy and Poist (2006); Lorentz et al. (2013)
Planning processes with other areas	Production scheduling, raw material planning, production planning and control	Murphy and Poist (2006); Jim Wu et al. (2013)
Inventory Management	Inventory management, inventory/JIT	Murphy and Poist (2006); Lorentz et al. (2013)
Legal, customs, and tax aspects	Knowledge of contractual and legal terms, law and regulation awareness, customs regulations	Onar et al. (2013; Jim Wu et al. (2013)
Quantity discounts	Negotiation, negotiate, purchasing capability	Gammelgaard and Larson (2001); Murphy and Poist (2006)
Negotiation practices	Negotiation, negotiate	Gammelgaard and Larson (2001); Murphy and Poist (2006)
Manage a large supply base	Sourcing and supplier management, supplier selection, purchasing	Lorentz et al. (2013); Derwik et al. (2016)
Business Promotions	New, based on business practices	N/A
Order aggregation	Order management	Murphy and Poist (2006); Derwik et al. (2016)
Integrated logistics	Visibility requirements of supply chain, integrating processes with supply chain partners	Prajogo and Sohal (2013)
Customer services	Customer management, MRO and after sales support, parts and service support, customer services	Murphy and Poist (2006); Lorentz et al. (2013)
Quality management	Formulate and manage logistics performance indicators, performance evaluation, quality management, quality, and service	Jim Wu et al. (2013); Campos et al. (2019)
Sustainability (environmental, social, and economic)	Ethics/CSR/Sustainability, develop sustainable practices, sustainability awareness, environmentally conscious, scrap disposal	Onar et al. (2013); Jim Wu et al. (2013)
(iv) Processes and Technology		

Understand about operational systems (WMS, S&OP, TMS)	Systems concept, technology awareness, information systems, IS for logistics,	Bernon and Mena (2013); Lorentz et al. (2013)
Understand about management systems (SAP, Oracle, ...)	Database ability, IT systems development, computer programming, software knowledge, knowledge of Latest technology, knowledge of newest techniques, ERP Systems	Gammelgaard and Larson (2001); Onar et al. (2013)
Understand about e-commerce systems	Efficient consumer response (ECR), e-commerce	Murphy and Poist (2006); Campos et al. (2019)
Understand about general system and process integration	Knowledge of basic computing, information technology, integration of system and process information, information integration	Lorentz et al. (2013); Campos et al. (2019)
Analytical and quantitative reasoning (statistics, math)	Quantitative methods, statistical analysis, analytic reasoning	Gammelgaard and Larson (2001); Onar et al. (2013)
Project management	Manage logistics improvement and projects, project management, project scoping	Gammelgaard and Larson (2001); Onar et al. (2013)
Problem diagnosing and solving techniques and tools (PDCA, Lean, TQC, excel, modeling)	Quantitative methods, critical reasoning, problem solving, spreadsheet abilities, sourcing analysis, simulation, and modelling	Gammelgaard and Larson (2001); Murphy and Poist (2006)
(v) Please rate the degree of familiarity that the logistics / supply chain professional should have regarding the following areas of the organization:		
Familiarity with Finance area	Finance	Onar et al. (2013)
Familiarity with Accounting area	Accounting	Sohal (2013)
Familiarity with HR and People Management areas	Human resources management, interconnection with human resources	Murphy and Poist (2006); Onar et al. (2013)
Familiarity with Marketing area	Sales and marketing management, marketing	Jim Wu et al. (2013)
Familiarity with Sales / Commercial area	Selling	Gammelgaard and Larson (2001)
Familiarity with Purchasing area	Purchase of goods, commercial awareness, purchasing/procurement	Onar et al. (2013); Campos et al. (2019)

Source: The authors themselves